WINTER CRUDE PROTEIN AMONG ACCESSIONS OF FOURWING SALTBUSH GROWN IN A UNIFORM GARDEN

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Abstract.— Winter crude protein content was determined for the current year's growth of 43 accessions of fourwing saltbush (*Atriplex canescens*) grown on a uniform garden. The crude protein level varied among accessions from 6 percent to 14 percent of dry matter. Individual plants (215) ranged from 5.3 percent to 17.1 percent. The mean winter crude protein level was 9.6 percent. Because these data were generated on even-aged plants, it appears that genetic variation plays an important role in determining the level of crude protein in fourwing saltbush.

Protein is one of three nutrients commonly listed as being deficient in the winter diet of mule deer and livestock on native ranges (Dietz 1965, Halls 1970, Nagy and Wallmo 1971, Welch and McArthur 1979a). Plants that retain significant amounts of green leaves during the winter usually contain higher levels of crude protein than those that shed their leaves (Ensminger and Olentine 1978, Monsen et al. [in preparation[3]]). There is some indication that individual plants and accessions of fourwing saltbush (*Atriplex canescens*) vary in the number of leaves retained during the winter (Plummer et al. 1966, McArthur et al. 1978). This differential retention of winter leaves among individual plants and accessions of fourwing saltbush is probably associated with differences in winter crude protein content (Monsen et al. [in preparation[3]]). We, therefore, undertook this study to determine if some accessions of fourwing saltbush grown on a uniform garden produce significantly higher levels of crude protein than others.

Materials and Methods

A uniform garden was located about 8 km south of Bliss, Idaho. Prior to planting, the garden was cleared of Wyoming big sagebrush, *Artemisia tridentata* ssp. *wyomingensis*, and associated perennials and annual grasses. Cultural methods were used to control the weeds.

Fourwing saltbush seed was collected from 60 native stands in eight states (Table 1). The seeds were stratified and then planted in small containers for the production of containerized stock. Following germination, the seedlings were grown in a greenhouse for approximately 10 weeks. The seedlings were then hardened off and planted in the garden during the spring of 1977. For each accession, 20 plants were planted on a 2.5 m grid within each of four plots in the garden.

From this garden, 43 accessions of fourwing saltbush were selected from one plot to evaluate the variation of winter crude protein levels. Table 1 lists the county and state where the seeds for each accession were collected. From each accession, 5 plants were selected at random for this study. Current year's growth was collected at random throughout the entire crown of the plants. Samples were placed in paper bags and transported to the laboratory and allowed to air dry for 5 days. Then, the samples were ground in a Wiley mill and passed through a 1 mm screen and oven dried at 100 C for 48 hours. Total nitrogen was determined by the Kjeldahl method as outlined by the Association of Official Analytical Chemists (1980). Crude protein was calculated by multiplying the nitrogen content by 6.25 (Association of Official Analytical Chemists 1980). Data were expressed on a percent of dry matter basis.

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[3]Monsen, Stephen B., Bruce L. Welch, and Nancy L. Shaw. Winter leafiness and crude protein content of antelope bitterbrush, desert bitterbrush, cliffrose, and Apache-plume accessions grown in a uniform garden. In preparation.

A completely random analysis of variance (P = .01) was used to detect significance among the 43 fourwing saltbush accessions. Hartley's test (P = .05) was used to test for significant differences among accession means. Percentages were transformed to Arcsin to avoid inequalities (Snedecor and Cochran 1967).

Results and Discussion

The crude protein levels of the 43 accessions ranged from 6.0 to 14.2 percent with a mean of 9.6 percent (Table 2). The crude protein of individual plants (215) ranged from 5.3 to 17.1 percent.

TABLE 1. Location of fourwing saltbush seed collection areas by county and state. Names given in parentheses are either towns or geographic features near the collection site.

1. Juab County, Utah (Jericho)
2. Kane County, Utah (Kanab)
3. Washoe County, Nevada (Reno Experiment Station)
4. Emery County, Utah (Hiawatha)
5. San Juan County, Utah (Monticello)
6. Owyhee County, Idaho (Reynolds Creek)
7. Lincoln County, Nevada (Panaca)
8. Sanpete County, Utah (Fayette)
9. San Juan County, Utah
10. Iron County, Utah (Lund)
11. Delta County, Colorado (Delta)
12. Unknown, Arizona (Little Colorado)
13. Navajo County, Arizona (Keams Canyon)
14. Rio Arriba County, New Mexico
15. Millard County, Utah (Garrison)
16. Sweetwater County, Wyoming (Green River)
17. Rio Arriba County, New Mexico (Rincon Blanca)
18. Emery County, Utah (Huntington)
19. Juab County, Utah (Nephi)
20. Coconino County, Arizona (Kaibab National Forest)
21. Emery County, Utah (San Rafael Swell)
22. Juab County, Utah (Excel Canyon)
23. Mesa County, Colorado (Grand Junction)
24. Garfield County, Utah (Escalante)
25. Iron County, Utah (Cedar City)
26. Elmore County, Idaho (Bliss)
27. Washington County, Utah (St. George)
28. Uintah County, Utah (Manila)
29. Carbon County, Utah (Ivy Creek)
30. Beaver County, Utah (Milford)
31. Sanpete County, Utah (Ephraim)
32. Wasatch County, Utah (Timpanogos)
33. Millard County, Utah (Desert Range Experiment Station)
34. Washington County, Utah (Pine Valley)
35. Gunnison County, Colorado (Gunnison)
36. San Juan County, Utah (Fry Canyon)
37. Juab County, Utah (Tintic Valley)
38. San Juan County, Utah (Mexican Hat)
39. Emery County, Utah (Emery)
40. Coconino County, Arizona (Tuba City)
41. Uintah County, Utah (Randlett)
42. Bighorn County, Montana (Decker)
43. Washington County, Utah (Jackson Springs)

These crude protein values compare to big sagebrush 12.4 percent (Welch and McArthur 1979a, 1979b), curlleaf mahogany 10.3 percent (Smith 1952, Austin and Urness 1980), chokecherry 9.9 percent (Smith 1957), desert bitterbrush 9.0 percent (Monsen et al. [in preparation[3]]), Stansbury cliffrose 8.6 percent (Smith 1957, Monsen et al. [in preparation[3]]), antelope bitterbrush 7.8 percent (Smith 1952, Bissell et al. 1955, Dietz et al. 1962, Monsen et al. [in preparation[3]]), and dormant grass 3.7 percent (National Academy of Science 1964).

Analysis of variance detected significance (P = .01) due to accession (Table 2). Hartley's test detected that some accessions contained significantly higher levels of winter crude protein than others. Accessions from Washington County, Utah (Jackson Springs); Bighorn County, Montana (Decker); and Uintah County, Utah (Randlett) contained the highest winter crude protein among the 43 accessions tested. Accessions collected from Juab County, Utah (Jericho); Kane County, Utah (Kanab); and Washoe County, Nevada (Reno Experiment Station) contained the least amount of winter crude protein. There was significant variation among plants within a given accession. This is illustrated in Table 2 by the accessional coefficients of variation. The coefficients of variation for the 43 accessions ranged from a low of 3.4 percent to a high of 33.9 percent. The mean coefficient of variation was 17.2 percent. For those accessions with a large amount of variation, careful intra-accessional selection could greatly improve the winter crude protein levels of these accessions.

There is some evidence that accessions of fourwing saltbush growing in a uniform garden may vary in other important characteristics, such as palatability, productivity, and adaptability (Van Epps and McKell 1978, McArthur et al. [in preparation[4]]). Our main objective in the selection and breeding of

[4]McArthur, E. Durant, A. Clyde Blauer, and Richard Stevens. Differential adaptation and production among accessions of fourwing saltbush grown on uniform gardens. In preparation.

TABLE 2. Hartley's test of winter level of crude protein (percent dry matter) among 43 accessions of fourwing saltbush* (*Atriplex canescens*). Five plants per accession. Also accessional coefficient of variation is given.

Accession number	Percent crude protein	C.V.
1	6.0**	14.0***
2	7.1	17.3
3	7.5	11.4
4	7.6	16.0
5	7.7	7.1
6	7.7	9.9
7	7.8	16.4
8	7.9	19.9
9	8.0	18.5
10	8.0	24.1
11	8.1	8.4
12	8.1	12.3
13	8.2	3.4
14	8.3	15.9
15	8.3	14.2
16	8.6	23.5
17	8.7	33.9
18	8.9	24.1
19	9.0	31.5
20	9.1	16.3
21	9.2	14.7
22	9.2	7.2
23	9.3	9.9
24	9.3	10.4
25	9.5	20.8
26	9.6	5.9
27	9.8	29.7
28	9.8	18.7
29	10.0	8.3
30	10.2	28.1
31	10.2	23.7
32	10.4	14.2
33	10.6	13.9
34	10.9	28.4
35	11.5	22.8
36	11.7	10.3
37	11.9	16.7
38	12.0	25.5
39	12.2	22.7
40	12.9	27.8
41	13.8	11.2
42	14.1	21.5
43	14.2	10.8

*For location of accession see Table 1.
**Accessions sharing the same line are not significantly different at the 95 percent level.
***C.V. = Coefficient of variation—five replications per accession.

fourwing saltbush will be to combine high protein content with other desirable characteristics that will provide more nutrients for wintering big game and livestock.

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